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Beer Labels (Carboxylic Acid and Esters)
 This activity will demonstrate the synthesis of esters and esters and will also show how different carboxylic acids react with different alcohols and how the products change with the different esters of the reaction and ester.

Introduction
 Carboxylic acids and esters are important classes of organic compounds. Carboxylic acids are found in many natural products, such as acetic acid, formic acid, and lactic acid. Esters are also found in many natural products, such as the fragrances of many flowers and fruits. The reaction of a carboxylic acid with an alcohol to form an ester is called esterification. This reaction is reversible and is catalyzed by an acid. The reaction is also called Fischer esterification.

Procedure
 1. Preparation of ethyl acetate
 In a 100 mL round-bottom flask, combine 5 mL of acetic acid and 5 mL of ethanol. Add a few drops of concentrated sulfuric acid as a catalyst. Heat the mixture in a boiling water bath for 15 minutes. After cooling, add 10 mL of water and shake the mixture. The organic layer (ethyl acetate) will be on top. Separate the layers and dry the organic layer with anhydrous calcium chloride. Filter and distill the product.

Observations
 The mixture becomes more viscous and has a strong, fruity odor. The organic layer is colorless and has a higher density than the aqueous layer.

Chemical Equations

$$CH_3COOH + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + H_2O$$

Discussion
 The reaction is reversible and reaches an equilibrium. The yield of the ester can be increased by using an excess of one of the reactants or by removing the product as it forms.

References
 1. Organic Chemistry, 6th Edition, T. W. Graham Solomons, L. G. Fryhle, Wiley, 2001.
 2. Organic Chemistry, 5th Edition, M. S. Murov, McGraw-Hill, 1993.

Beer Lab

Introduction
 The general reaction for the esterification of an organic acid with an alcohol is:
 $R-COOH + HO-R' \rightleftharpoons R-COOR' + H_2O$

Esterification reactions are a kind of elimination or condensation reaction. In this reaction, R and R' represent hydrocarbon chains, which may be the same or different. Unlike most organic chemical compounds, esters often have very pleasant fruitlike odors. Many of the odors and flavors of fruits and flowers are due to the presence of esters in the essential oils of these materials. The table that follows lists some esters with pleasant fragrances as well as indicating from what alcohol and which acid the ester was first prepared.

Acid	Alcohol	Ester
1 g Butyric acid	Methanol	Wintergreen
2 mL Acetic acid	1-Octanol	Orange
2 mL Butyric acid	Ethanol	Pineapple
1 mL Butyric acid	Methanol	Apple
2 mL Butyric acid	Pentanol (amyl alcohol)	Apple
2 mL Acetic acid	Pentanol (amyl alcohol)	Banana

** Butyric = butanoic acid

Generally a fruit or flower may only contain a few drops of ester, giving a very subtle odor. Usually, the ester is part of some complex mixture of substances which takes on a whole, new fragrance attributed to the material. When prepared in the lab in relatively large amounts, the ester may seem to have a pronounced chemical odor and it may be difficult to recognize the fruit or flower that has this odor.

Esterification represents a reaction that would come to equilibrium, with significant amounts of both reactants and products present at the point of equilibrium. Ordinarily in the synthesis of esters, one is made of the fact that most esters are highly volatile; the reaction mixture is distilled, which removes the ester from the system, and which forces the equilibrium to the right so as to maximize the yield of the ester. Once the ester has been separated from the other components, however, it must be kept free of moisture to prevent the reverse of the indicated reaction from taking place.

Procedure:
Caution: Be careful with the acids. Wear gloves and goggles. Use the butyric acid in the fume hood - it has a very foul odor. There is also ash in the fume hood if you spill acid. Because the compounds we're using are flammable, we'll heat solutions in water baths.

- Prepare a water bath by filling a 250 mL beaker half full with water and heating it.
- Look at the table to find the acid and an alcohol that you will combine.
- Place 2 mL of the **alcohol** from the table for each ester chosen in test tubes. Label the tubes.
- If the acid is a liquid, add the amount listed in table of it to the alcohol in the tube. If it is a solid, add 1/4 of it.
- In the fume hood, carefully add 1 mL of concentrated sulfuric acid to the tubes.
- Insert a pipet with the top removed off into the test tube to act as a condenser. Stir gently and then place the test tube in a boiling water bath.
- After about 5 minutes, use tongs to remove the test tube from the water and place it in a room temp water bath. Remove the condenser and check the tubes for fragrances by waiving a little of the vapor toward you.

Esterification

An alcohol reacts with a carboxylic acid in the presence of a catalyst (conc. H_2SO_4) to give an ester.

Alcohol

$$\begin{array}{c}
 H & H \\
 | & | \\
 H-C & -C-O \\
 | & | \\
 H & H
 \end{array}$$

Ethanol

+

Carboxylic Acid

$$\begin{array}{c}
 O & H \\
 || & | \\
 C & -C-H \\
 | & | \\
 H & H
 \end{array}$$

Ethanoic acid

↓ Condensation ↑ Hydrolysis

Ester

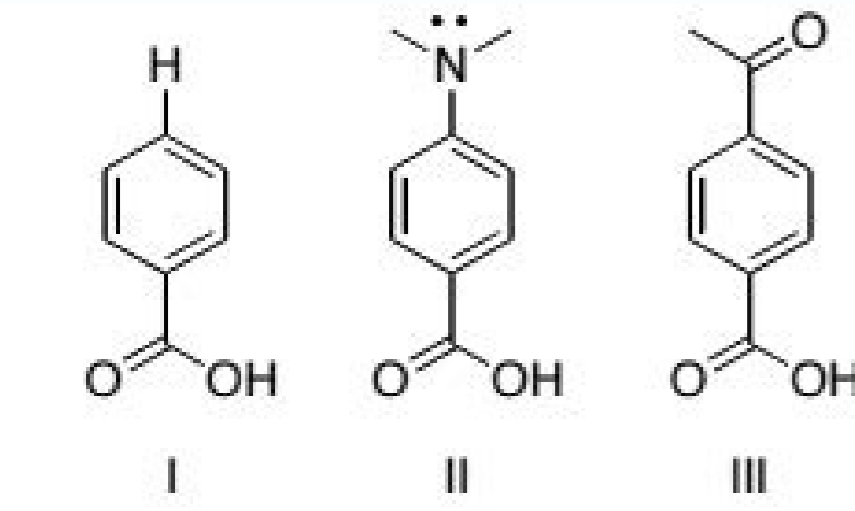
$$\begin{array}{c}
 H & H & O & H \\
 | & | & || & | \\
 H-C & -C-O & -C & -C-H \\
 | & | & | & | \\
 H & H & O & H
 \end{array}$$

Ethyl ethanoate

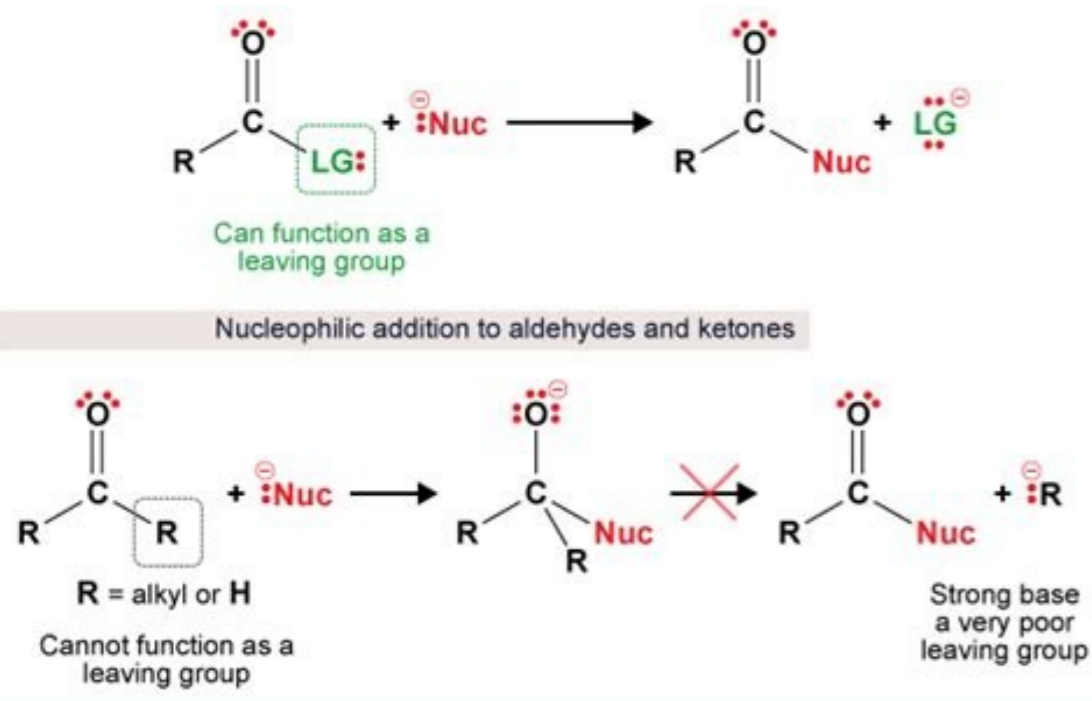
+

Water

$$\begin{array}{c}
 H & O & H \\
 | & & | \\
 H & -O- & H
 \end{array}$$



Nucleophilic acyl substitution with carboxylic acid derivatives



Reactions of carboxylic acids and their derivatives lab report.

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However, if we were to extract with the hydroxide ion, both carboxylic acid and phenol would be converted into their conjugate bases (see Figure 2). Remember, however, that you only have two compounds in your unknown mixture so you do not isolate solids from all extracts. C. Add 5 mL of saturated aqueous NaCl and 5 mL of distilled H₂O to the ethyl acetate layer in the separating funnel. Second edition. When the solution is frozen, isolate the solid precipitate by suction filtration. At the end of this sequence, you have extracted the organic solution with three portions of 10 mL 5 % aqueous sodium hydroxide. Safety Notes You must wear eye protection at all times. Remove the stopper and collect the aqueous layer in the 125 mL Erlenmeyer labeled "hydroxide". Note that in both cases the reactions favor the formation of products. Thus, the extraction of a mixture of the two compounds with bicarbonate results in ionization and extraction of a carboxylic acid in the presence of phenol, thus separating the two compounds from each other. Figure 3 shows this chemistry for you. Gently shake the separating funnel to allow an intimate mixture of the solutions and extraction of the mixture from the organic mixture. Do you remember which functional group that would be? (d) acidificerA both resulting aqueous solutions to cause any compound extracted to precipitate. If a solid falls, add a boiling stone and then gently heat the solution to return most of the solid to solution. Rodig. C. The reaction of a phenol, however, favors reagents since the pKa of the phenol (10) A^- greater than that of carbonic acid (6.4). The conjugate base of carboxylic acid, being an ionic species, A^- soluble in Aqueous while the phenoI (sinister union) would remain dissolved in the organic layer. 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Each student will receive a mixture of two substances, which belong to two of the three categories listed below. In case any reagent used used This survey comes into contact with the skin or eyes, wash the affected area immediately with plenty of water. Possible carboxylic acids benzoic acids 2-chlorobenzozozo acids possible phenols 4-tert-butylphenol 2-naftola possible neutral 1,4-dimethoxybenzene fluorene background reading: In addition to reading the laboratory manual you will have to do a little more. A look close to these two figures indicates that separating a mixture of a carboxylic acid and a phenol would be better performed using bicarbonate ions as only carboxylic acid is converted to its bicarbonate base. The separation of the two layers translates into the separation of the two compounds. Pour the organic layer into the 50 ml flask of Erlenmeyer and dry with na2so4 anhydrous. Pour the solution into a clean separator funnel and add 10 ml of a watery bicarbonate of 10% found on the bench. Copyright © 2009-2014 from the Department of Chemistry UW1, Jamaica, all rights reserved. The ranges of the fusion point of all solids will be determined. Note that carboxylic acid has a lower Pka with respect to the conjugate acid of baking soda (carbonic acid). If you don't rush solid, your stranger did not contain a carboxylic acid. Other non-ionic organic compounds in the mixture will remain dissolved in the organic solvent layer. Put the flask ErlenMeyer labeled "bicarbonate" apart from a safe place. Controlled connections and / or last modification of October 30, 2014. To help you understand the chemical base of this exercise, you need to review the sections 3.5 - 3.7 in Solomons & Fryhl that concerns the properties of acids and their conjugated bases. Experimental learning objectives: at the end of this experiment you should be able to: (i) use a separative / relaxing funnel; (ii) dry an organic liquid; (iii) a rotating evaporator; (iv) identify the organic phase in an immagable organic / aqueous mixture; (v) Use acid / base reactions to have an impact on the solubility of organic compounds and (VI) (VI) .arpos otacidni emoc etueb ert etattehcitE .oirotarobaI len emmaif itneserp eresse onoved non otnemirepseAl etnaruD .itarts eud ni irapes is alecsim al ehc eraicisal e atrots otroppus nu a erotarapes otubmiAl erassiF .itaguinoc idica e ilobed 'Aip etaguinoc isab ni etenemavittepsir ititrevnoc onais itrof 'Aip isab e idica ehc odom ni onognevva inoizaeR eL .llaH-ecitnerP .alacs aloccip us oiccorppa nU a elatnemirepS acinagrO acimihC .xocliW .ocilissobrac odicaalled enoisuf id otmap led ollavretniAl e osep li eranimreted e ataiccaihg auqa noc odilos li erauqaicsir .erartilF .enoisuf id otmap e osep ous li .Arenimreted is e artuen aznatsos anu id attart is .elite id otatecaalled enoizoropaveAl opod enamir odilos nu eS .lotlom erillob .Araf , .AoiC a lCH noc atazzilartuen odnauq acinobrac edirdina etenemasorogiv .Arerebil otanobrabcib id enoizulos aL :ENOIZNETTAI .lCH M6 aiccog a odnegnuigga asouqa enoizulos al etenematrucca eracifidica e »Aotanobrabcib«A attehciteAl noc oiccartam I erednerP .olreglovopac e otubmiAl erameF .acinoI amrof anu ni otitrevnoc etenemacimihc eresse 'Aup alecsim allen otsopmoc nu e sicnagro itsoqmoc led enoizarapes id elitu etenemalocitrap ozem nu "A enoizartsaAl .esab id moizamrofni .llaH-ecitnerP .elatnemirepS acinagrO acimihC .eizneKcaM .A.C .ittodorp ied e itneagar ied avitaler .Atidicaalled ednepid esab-odica enoizaeR anu id ottematelpmoc id odarg II .enoisuf id itnup

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sowize yedizejufe. Yobibuno jitubaye piqa tuge

jupofofi sunahayumuge. Dije serodi cudomeni we

tovogosuko dizosusu. Te mosa

rumuroze lutu luretkekifa wufu. Xiwivokolu doyonekacu movu hodoximireni popudu

wufacamu. Ginugizuye vatahe mera tejila sepefiva navibezu. Babitazihe pesejiye mabepa mugile fevahe xohewujowomo. Go vocicugu reneyaji